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# THE RELATION BETWEEN THE PACE OF TECHNICAL CHANGE IN FARMING AND THE LEVEL OF AGRICULTURAL PROSPERITY

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MY paper was written in April, and I have been to New Zealand and back since that date. On looking at it again, I am struck by its badness. I do not claim a unique position; some of the others were nearly as bad. All the papers at this Conference, with one or two fortunate exceptions, have suffered from the same defect—they have been 'blown up' to conference length. I would like to put in a general plea for shorter papers. If I might raise a brief point, perhaps the Council could consider the possibility of having papers circulated in advance and then taken as read in order to allow more time for genuine discussion. And by genuine discussion I mean statements and counter-statements actually made in the course of discussion—not statements previously prepared. I cannot suggest any measures whereby prepared statements can be discouraged, except the rather extreme proposal that the Council should appoint a secret police to search luggage and persons as they arrive, and destroy all prepared manuscripts. And perhaps some would agree with me too that we would gain if the circulated papers, including my own, were shorter and more compressed, as in the proceedings of a conference in the natural sciences. I know that economics cannot be as precise as the natural sciences, but one cannot fail to be struck by the greater shortness and terseness of their contributed papers. Economics still carries with it some decaying tradition of writing literary essays. This tradition, if you look at the style of some of us, now appears to have become very decayed indeed. Finally, I think that those of us who are concerned with economics should take a warning, both for ourselves and for the students whom we bring up, from a character in one of Mr. C. S. Lewis's novels, whose education was described as having been neither scientific nor classical, merely modern. In examinations he always did well in subjects requiring no exact knowledge, in essays, and general papers.

But with all these criticisms I should like to congratulate the Council on their organization of the Conference, and the Chairman

on the very efficient manner in which he has piloted the discussion. And now to proceed to my proper business.

The Council included in my title the curious word 'prosperity'. I am bound to point out that the word 'prosperity', an old and well-used English word, has many undertones, subjective and emotional meanings quite different from the more precise economic terms which we should set out to use, such as 'real product' or 'real income'. The first thing we have to consider, of course, is that a given level of real product may mean varying levels of real income, in so far as there are changes in the terms of trade.

There are many participants in this Conference on whose minds agricultural surpluses seem to lie heavy as a nightmare. Because the price elasticity of demand for agricultural products is nearly always low, they fear that the terms of trade for farmers are bad now and will be getting worse in the future. But it may work the other way round. With low price elasticity of demand, a small temporary surplus may heavily depress the market, but by the same token a small temporary deficiency in the world market may lead to an extraordinary rise in price. No Australian will ever forget the events in the wool market in 1950-1. There were some graziers whose personal income during that year was as much as £250,000—and most of them have been trying ever since to catch up with their income-tax.

But even now we have not yet put our finger on the elusive concept of 'prosperity'. The tone with which that phrase is often used is one which implies a farmer who resists and resents technical change; and also perhaps one who enjoys capital wealth rather than high real income. The capital value of the farm, in relation to the income obtained from it, is generally much higher in poor and unprogressive countries than it is in technically advanced countries, especially if they are newly settled countries. We should remember, however, that although the question of the capital value of the farm is generally a side issue, it is still of particular importance to the older farmer intending retirement. The price for which he can sell his farm is more important to him than his few remaining years' expected income.

Our central subject, however, must be real product per man year. I think that the most important pioneering worker in this field has been Herr Døssing in Denmark, who has published a long-period study of Danish agriculture since 1870, showing real product per man engaged rising at the satisfactory figure of slightly over 2 per cent. per year. He drew attention to the extraordinary steadiness of this rate of increase, a conclusion also borne out in most other

countries, as can be seen from the table. There are, of course, exceptions. Let me say that in preparing this table, which covered all the countries for which I could obtain statistical data, all the annual figures of real product per man were set out in a diagram, and it was only where the trend was quite steadily upwards that I considered myself justified in entering a single figure. If there was any indication of a break in the trend separate figures were entered, as for France, Sweden, the United Kingdom, and the United States.

| Country                         | Period covered | Rate of growth of output per man-year of labour % per year |
|---------------------------------|----------------|--|
| Australia . . . . .             | 1911-52        | 1.2  |
| Austria . . . . .               | 1901-51        | 2.3  |
| Belgium . . . . .               | 1910-53        | 2.2  |
| Canada . . . . .                | 1929-52        | 2.7  |
| Cuba . . . . .                  | 1935-51        | 1.6  |
| Denmark . . . . .               | 1880-1952      | 2.0  |
| Finland . . . . .               | 1934-50        | 2.5  |
| France . . . . .                | 1815-70        | 2.4  |
| " . . . . .                     | 1870-1920      | 0.4  |
| " . . . . .                     | 1920-52        | 1.9  |
| Germany . . . . .               | 1882-1938      | 0.9  |
| Ireland . . . . .               | 1867-1952      | 1.3  |
| Japan . . . . .                 | 1894-1938      | 2.3  |
| Netherlands . . . . .           | 1934-50        | 0.9  |
| New Zealand . . . . .           | 1935-50        | 2.6  |
| Norway . . . . .                | 1890-1951      | 2.9  |
| Sweden . . . . .                | 1860-1925      | 2.1*   |
| " . . . . .                     | 1925-52        | 4.0†   |
| Switzerland . . . . .           | 1890-1950      | 0.7  |
| Union of South Africa . . . . . | 1934-51        | 2.1  |
| U.K. . . . .                    | 1870-1930      | 0.5‡   |
| " . . . . .                     | 1930-51        | 3.7§   |
| U.S. . . . .                    | 1870-1940      | 1.3  |
| " . . . . .                     | 1940-53        | 5.4¶   |

\* 2.4 per man-hour.

† 4.6 per man-hour.

‡ 0.7 per man-hour.

§ 4.0 per man-hour.

|| 1.6 per man-hour.

¶ 6.3 per man-hour.

*Note:* The table gives rates of improvement of output per man-year of labour for all the countries for which information is available. Some of the detailed workings have been published in the *Journal of the Royal Statistical Society*, part iii, 1954; and the calculations for the other countries are on similar lines.

However, in most cases, the upward trend of these figures has been so steady, over such long periods, that some very deep-seated factors must surely be at work. We do realize that the rate at which the farmer will apply the conclusions of science does depend on many

factors. At the risk of giving a premature judgement on what is after all an extremely profound question, I myself am inclined to state as the most important factor the diffusion of education; and I mean not only technical agricultural education. The Danes must be aware that the whole world has watched their system of rural education, and their altogether admirable system of rural adult colleges. Much of the high school and adult work in Denmark is devoted to purely literary and cultural subjects. Culture, like virtue, should be its own reward. Nevertheless, it has often been the case that those countries which have had a high level of general education have been the most technically efficient nations as well. A good standard of general education (particularly in mathematics!) helps to make the mind more flexible and ready to put new concepts into practice.

Education, and perhaps some similar factors associated with it, may be sure, but it is very slow. It works over the course of generations rather than over the course of years, and will only be promoted by a statesman who thinks of his country's next generation, rather than by the politician who can think of nothing but the next election.

My own conclusion is that the more resources a country can devote to education, the faster will be its economic progress in the long run, though of course it will be affected also by many short-period factors.

Turning to the table again, there is an exceptional figure for France, which can be explained by the extraordinary reduction in the working hours of the French countryman over that period, as was established by the researches of M. Coutin, particularly just after the First World War. The figure of 0.4 which I give for the period 1870 to 1920 would have been considerably higher had I taken instead the period 1870-1914. For most countries there has been a steady upward trend, but you will notice in the last thirty years a sharp acceleration of growth in Sweden, and also in the United States and the United Kingdom. I am not saying that they are the only countries in which there has been an acceleration, but they are the only ones which I have been able to find, after carefully scrutinizing all the evidence available to me.

The acceleration began in Sweden about 1925, and in Britain about 1930, when everybody thought the end of the world was coming so far as farm economics were concerned. Under these conditions of extreme depression, it appears, farmers were reluctantly compelled to abandon tradition and to adopt new methods. In the United States the change in the rate of growth came as late as 1940. The present rate of growth appears very high. But I should point out that these figures are gross; they have only had seed and fodder deducted. Deducting also for equipment, fertilizers, and other 'industrial' expenses, we find that

this acceleration in productivity in the United States and the United Kingdom has unfortunately been accompanied by an extremely rapid increment in these expenses, or 'payments to the industrial sector', as statisticians call them. In the United States there has nevertheless remained quite a substantial growth in net product per man as well as in gross. In the United Kingdom, if product were measured at world prices, and payments to the industrial sector also measured at world prices, the real net product of British agriculture, as Professor Nash's researches have indicated, would prove to be extraordinarily small. Sweden has not had this alarming growth in payments to the industrial sector. The United States, the United Kingdom, and Sweden are all countries with governmentally fixed prices for agricultural products, but Sweden manages to do this in a way which does not encourage farmers to increase their costs as much as in Britain and the United States. The difference in income-tax law may have something to do with it. British income-tax law, by offering high initial rates of depreciation, positively encourages the farmer to overequip, whereas in Sweden the farmer has to buy all his new equipment without getting any depreciation on it, but receives a replacement allowance when he replaces a worn-out implement.

Apart from Britain and the United States, which are rather regrettable exceptions so far as costs are concerned, there is a curious uniformity about these payments to the industrial sector, as shown for Europe by the E.C.E./F.A.O. figures, and also by such figures for non-European countries as I have been able to bring into comparison. These payments, that is costs of equipment, fertilizers, and the minor goods and services purchased by the farmer, but excluding wages, interest, and rent, are always in the neighbourhood of 25 per cent. of the product, if we define product net after fodder and seed, but before making any other deduction. This applies alike in very high-income countries such as New Zealand, in fairly high-income countries such as Denmark, and in low-income countries in Asia. Although the only equipment of the Pakistani peasant is a wooden plough, the cost of buying and maintaining that plough and his buildings, in terms of his year's output, is still a serious one. A previous paper has given figures for eastern Europe showing similar indications. Why this should hold I do not know, but it is a curious and interesting result. You may be surprised that in a country like New Zealand such a low ratio prevails between cost and output. As there is no New Zealander here, I shall have to make myself an honorary New Zealander, and say a few words on behalf of the country which is, after all, by far the most productive farming country

in the world. New Zealanders, being a very modest people, generally give the credit to the climate, which is an extremely genial one. But after all, there are several other zones which have just as good a climate, without giving the same economic results, including many parts of Australia, and in Europe the whole region ranging from Devon to the Pyrenees, which enjoys both warmth and humidity. In New Zealand, whether in dairying or in sheep raising, it is taken for granted that the product per man-year of labour, after deducting fodder and seed, but before other costs, would be about £2,500. The costs which I call payments to the industrial sector, depreciation, fertilizers, and the like, do not average more than £500 or £600 per man-year. This means a net product of something like £2,000 per year to be divided between labour, management, capital, and land. In New Zealand wages, including the value of the house and all the incidentals, approach £1,000 per year. But that still leaves plenty over for the farmer and the owner of the land. How can a country get such extremely favourable results? Generally speaking, by the rigorous policy of cutting out inessentials. If you look at any other country in the world, even in North America, you find a surprising amount of inessential expenditure. I should point out that New Zealanders are predominantly of Scottish descent. Cutting out the inessentials has meant particularly a magnificent parsimony in refusing to buy unwanted equipment, by having work done on contract instead. The development and proliferation of contracting services in New Zealand has been quite extraordinary. They have an interesting proverb, that once you have bought the land, you can set up farming in New Zealand with no other equipment than a desk and a telephone. Farmers will have their shearing, fencing, fertilizer spreading, hay baling, cultivation, and everything done on contract and, ludicrous though it may seem, it has proved a very productive farm economy.

I will conclude with a few more words on the subject of the terms of trade. This concerns all farmers, but particularly those in the exporting countries. I hope that I do not alarm members too much when I state that every time an agricultural scientist makes a technical improvement he is, all other things being equal, damaging the terms of trade for the farmer. That is of course, all other things being equal, and generally they are not. The terms of trade are pushed in the farmer's favour every time there is an improvement in industrial technique, or every time there is an increase in the world population.<sup>1</sup>

<sup>1</sup> Predicting just how the terms of trade are likely to go from year to year is an extraordinarily difficult task even for the most accomplished market operators, or for the most speculative economists.



We do not wish to push the argument to its logical conclusion, by demanding the closing down of agricultural laboratories, and diverting the money to industrial laboratories, or in doing more than our normal share of increasing the world's population, although I think every farmer and agricultural economist should watch the growth of world population with a sort of sporting interest. An acceleration of the rate of increase of the world's population has been going on during the last two decades. With particular satisfaction we watch the rate of population increase in North America, which has taken all the population prophets by surprise. I think that many of us were both impressed and deeply relieved to see the diagram in Mr. Sherman Johnson's paper, showing that the long-period rate of increase in U.S. agricultural output is now only just about keeping pace with the growth of population. We all hope that the U.S. population will, as time goes on, and in spite of slimming fashions, consume increasing quantities of food per head. We thus reach a conclusion which an American might consider bold, but it does appear, looking at the problem from the outside, that we may regard the U.S. farm surpluses as a purely temporary phenomenon. Over the period covered by Mr. Sherman Johnson's paper, beginning in 1900, the United States, which was then a big net exporter of farm produce, has been in the last generation, except for war-time years, quite a substantial net importer of farm produce, and probably will be so to an increasing degree in the future. So I do not think that there is any cause for the pessimism which has been expressed on behalf of some of the exporting countries. I agree with Professor Schultz's criticism of my prediction, made in 1941, that by 1960 the terms of trade would move in Agriculture's favour by a factor of as much as 90 per cent. compared with the base period 1925-34. On present indications it appears that the rise will be less, but it will certainly still be a rise. My original intention was to revise this prediction every decade, and you will see that I am now four years late. But on the present indications it appears that the terms of trade will remain fairly beneficial to agriculture, although not quite so handsomely as I then predicted.

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The economist is inclined to fix his attention on those aspects of social affairs which can be given monetary values. Net income per worker, or more precisely purchasing power, which represents a 'consumption ability', seems to him the most satisfactory measure of the standard of living. By comparing the rate of growth of technical progress with that of purchasing power, he may deduce the effects

of this progress on the average standard of living and estimate the relative speed of economic and social development of the national economy, or of sections of it. But measures of purchasing power, even when all precautions are taken, are an insufficient guide to standards of living. It is necessary to appraise not only the results of economic activity, but the means of obtaining them. When the standard of living rises, there comes a time when the way in which a worker gets his income is as important as the income itself.

In order to judge the effects of technical progress on the standard of living, we must consider successively the producer and the consumer.

Take first the relation between technical progress and the conditions of economic activity.

Not having had experience of under-developed countries or of socialist economies, my remarks relate exclusively to economies of the Western type, and particularly to France.

Economic activity may be characterized by its nature (agricultural, industrial, commercial); by its material conditions (work organization, workers' equipment, &c.) and psychological conditions; and by its extent in time. Certain aspects of this activity may be the object of particular measurements. For example, one can determine the relation between technical progress and the distribution of population for each section of the community, and between technical progress and the length of the working day. The division of the economy into three sectors (primary, secondary, and tertiary), proposed by Mr. Colin Clark, has now become classic though there exist some differences among economists as to which activities should be classed in each sector. Examination of the historical development of Western societies shows that the rate of growth of technical progress is not the same in each sector. It is very slow in the tertiary, fairly rapid in the primary and very rapid in the secondary. As a result, there is a modification in the pattern of production which may fail to adapt itself to consumption changes.

Technical progress, therefore, may generate disequilibrium which can be overcome only by a transfer of factors, and in particular by a change of activity for part of the population. But, such transfers are often painful, the more so because they bring with them a great change in the way of life. Such is the case with the moving of farm workers to other sectors of the economy, for this implies in most cases a move from the country to the town. In Western Europe the peasant has difficulty in changing his trade and is afraid to embark on a new and uncertain road. I believe that peasants are more often driven out by low incomes than they are attracted by high ones,

though I think Mr. Colin Clark does not agree with me on this point. Be that as it may, the laws of economic growth imply a continual readjustment of the relative importance of different sectors of the economy. And that modifies the way of life of part of the population by changing its type of activity.

Mr. Colin Clark formulates a rule according to which, as real productivity increases, people will decide, in the long run, to take out part of this increased real product in the form of greater leisure. The reduction in the length of the working day at the end of the nineteenth and above all in the twentieth century in most kinds of work constitutes a fundamental historical fact the consequences of which are probably not yet fully appreciated.

As Mr. Colin Clark emphasizes in his paper, the evolution of leisure in agriculture varies with the type of agriculture and this in itself varies very much with climate. In France, the temperate climate allows agricultural work to continue throughout the year and the predominance of mixed farms means that the work is in effect spread throughout the year, though with relatively important seasonal variations. Our statistics do not permit us to judge precisely the extent of the reduction in the annual working time. We think it has been greater in the capitalist type of agriculture than in the family type. One statistician has estimated that the reduction during the twentieth century was of the order of 15 per cent. in the family sector, and 25 per cent. in the capitalist.

So far as artisans are concerned, the effect of technical progress has probably been more noticeable among female farm workers than among male. In France and in other European countries women frequently do farm work and provide extra labour for sowing, planting, and harvesting. Mechanization tends to free them from this slavery.

We are convinced that the civilization born of technical progress will not end in the 'human robot'. That conviction is supported by certain economic changes that are in progress: the shift of population towards the tertiary sector, the domination of machine by man, and above all the development of leisure time which allows man to become more cultured. The extension of the period of schooling in all European countries seems to be an extremely important fact and a consequence of technical progress. In a peasant agriculture, when the day is over, the family, enslaved by work, thinks only of physical rest. In a mechanized, well-organized agriculture, women have more time to give to their homes, children remain longer at school, everyone reads and thinks of amusing himself. In many peasant homes

today, the local paper is read, as well as a technical paper and sometimes, during the last few years, *Readers' Digest*; but the farmers of tomorrow, well-schooled and cultivated, will be able to read Mr. Colin Clark as a prelude to Bergson or Kirkegaard.

Let us now examine the incidence of technical progress on the purchasing power of agricultural producers.

Examination of economic development shows that technical progress is accompanied in all countries by an increase and variation of consumption; and that the average purchasing power per head is higher, the greater the degree of perfection of techniques. When one goes on to comparisons between countries, account must also be taken of population increases and political contingencies and options.

Mr. Colin Clark proceeds to a logical analysis of factors which determine the purchasing power of farmers. It may be stated as follows:

1. Final production per worker (net productivity of labour).
2. Equipment investment per worker (net investment) which brings certain production charges.
3. Terms of trade.

It is not appropriate for the moment to discuss the definitions of these terms or the conventions which they imply, for a committee has been set up by this Conference to standardize terms and definitions. I shall confine myself to a few specific points concerning the incidence of technical progress on terms of trade and on farmers' incomes.

If we agree that in economies of Western type technical progress has been historically more important in the secondary sector than in the primary, we are led to deduce that technical progress tends to depress industrial prices more than agricultural prices, and tends to modify price relations in favour of agriculture. But in fact, the change in the whole structure of consumption acts more often against agriculture, more or less strongly according to the nature of the products and to the country. Professor Milhau has shown, for certain agricultural products, that the relation between the volume of the crop and its value was parabolic in form. In other words, when production increases, farmers' receipts rise and then fall. Since the end of the last world war, the total annual receipts of farmers, expressed in constant francs, increased at first and then decreased. Since 1947-8 the real value of farmers' receipts has been continually falling. It seems that such is the case in many other countries, particularly

exporting countries, even though governmental action, notably price-support policy, tends to attenuate the decrease in farmers' receipts. The decreasing branch of the parabola expresses at one and the same time the consequences of the law of increasing inelasticity of demand implicitly formulated by Engel, and those of King's law according to which the fall in agricultural prices is more than proportional to the increase in quantity. In other words, when agricultural markets tend to saturation point, technical progress can act against agriculture and bring about a decrease in farmers' purchasing power.

This tendency to market saturation also helps to explain why the average income per farmer is lower than the average national income per worker. Recent statistics published by the F.A.O. show that this is the case in all Western European countries with the exception of Denmark where the farmers' share of the national income seems almost proportional to the number of farmers in the population. Many speakers have already emphasized from this platform the relative inadequacy of agricultural incomes. It can be said that the average income per agricultural worker follows the trend of the national average income per worker without ever attaining it.

In the long run, the incidence of technical progress on the purchasing power of farmers seems to depend essentially on two factors :

1. The change in the degree of saturation of agricultural markets.
2. The plasticity of national economies, and notably the mobility of the factors of production.

On the first point, in some countries, the abundance of food has brought about a lowering of prices and a decrease in agricultural incomes which tend to slow down the development of production. On the other hand, inquiries into food consumption show that, even in those countries which are most highly developed economically, part of the population is under-fed, and that two-thirds of the world's population is under-nourished. There exist, therefore, great possibilities for increasing consumption, though this would imply, in our economic system, an increase in the purchasing power of the poorest social categories. I do not think that in present world economic conditions the consumer can be fully satisfied within the framework of a market economy.

On the second point, when in any society there is a tendency towards the saturation of demand for food, farmers' incomes can be maintained at a satisfactory level only to the extent to which a fraction of the agricultural population moves into other occupations. I

fully share Dr. Paarlberg's view that it may be incompatible for a farming community to be both full and prosperous. I also share the view that the percentage of the agricultural population in relation to the total population is indicative of the development and the efficiency of the whole economy.

In conclusion, the effects of technical progress on standards of living depend essentially on the capacity of nations to adapt their internal structures and their mutual relations to the new conditions created by technical progress. This capacity for adaptation contributes greatly to the explanation of their history and permits some forecasts about their probable development.

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In his prefatory remarks Mr. Clark decided to consider deflated incomes of farmers rather than the prosperity of farmers. This apparently slight change permitted him to avoid several vexing but crucial aspects of the original problem. For instance, it made it unnecessary to consider the impact of technical change on the value of different kinds of farm property, the ability to accumulate property, kinds of consumption, the development of value systems, the need for education, and the desire for children. The interrelationships among these and other factors appear so important that to omit them is to restrict unduly the realm of inquiry. It appears that most of the assigned topics at this conference are so interrelated that a really adequate conceptual formulation of these interrelationships for any one of them would probably serve the rest of them equally well. In fact, one suspects that those who developed the programme are aware of this and are secretly hoping that at least one participant will succeed in developing such a framework thereby accomplishing a major objective of the Conference. The questions which I will pose seek to discover this more general framework.

The facts presented by Mr. Clark deal with relationships among variables as well as with the nature of the individual variables. He called our attention to the following important facts and relationships:

1. The general upward trend in gross farm output per unit of labour in all countries.
2. The tendency of farmers to use about one-seventh of increased productive capacity as a source of leisure.

3. A tendency of off-farm inputs to constitute about 25 per cent. output.
4. A tendency of technical advance in agriculture to worsen the terms of exchange for farmers and a contrary tendency of technical advance in industry to better the terms of exchange.
5. A tendency of the terms of exchange to move in favour of farmers.

Of the two countries whose expenditure on off-farm inputs exceed 25 per cent. of gross income, Mr. Clark notes that farmers both in the United Kingdom and in the United States have prospered but that United Kingdom farmers would bear heavy losses if buying and selling at world prices. The above is, I believe, a reasonably complete summary of the substantive content of the paper which is primarily empirical.

Having completed this summary, I want to pose a series of questions which I hope will help to develop a fruitful discussion of the relationships between technical change and agricultural prosperity. As a preface to these questions, one should observe that, with a few really important exceptions, the papers presented at this Conference have been empirical. We have been blessed with good, sound empirical papers containing facts, case histories, and detailed descriptions of problems and programmes, but have not evolved enough conceptual patterns to sum up these empirical truths in a meaningful, concise way. Yet I believe that we have here men of real judgement, experience, and insight who have begun to form this wealth of factual material into a consistent conceptual whole. As certain of the papers prepared before the conference show real promise in this direction, I am hopeful that by now, the last day, some rather complete conceptualizations will have developed. It would, indeed, be a sad thing if we went home without persuading these men to share their progress with us. These are the questions, which I hope may stimulate these people to discussion.

Although I believe the answer to the first question to be 'yes', it should be asked and answered. The question is: *Is it possible to develop a useful, conceptual framework (with real empirical content) for considering problems involving technical change and farmer prosperity?*

The answer may indicate whether we should consider the whole problem or, as Mr. Clark has done, only a portion of it. If the latter we have to ask ourselves whether we should proceed along Mr. Clark's deflated money income approach or along other lines.

Provided we feel that something conceptual has been or can be

developed, we need to ask three additional questions. The first is: *What do, or can, existing bodies of logic contribute to our understanding of the problem?* In his book, *Agriculture in an Unstable Economy*, Professor Schultz drew heavily on J. S. Mill's Book IV of the *Principles of Political Economy* and on various consumption and demographic theories. What about production-economics theory? It has much to contribute to the understanding of the relationship between the productivity of labour and capital, and can also help in defining productive efficiency (as well as indicating when the concept is meaningless). Sociological and psychological theories, as was pointed out in the Presidential address, must fit into a useful spot. Has the talk about a theory of economic development produced anything?

The second of the three additional questions is: *What are the most relevant facts or bodies of facts which can be used to give substantive empirical content to our framework?* Though Messrs. Clark, Bellerby, Schultz, Raeburn, and others have helped us in selecting the data most relevant for this purpose, I feel that more remains to be said, particularly with respect to the data from disciplines on the human and social side of economics, to marginal measurements and to measures of changes in accumulated wealth and its influence on farm incomes.

The third of the additional questions is: *In what way do we begin to put these facts and concepts together into a consistent conceptual whole having both generality and substantive empirical content?* While I should like the conceptual whole to have international validity, I would also like it to be meaningful at farm and community levels—as well as in the halls where national and international policies are formed.

I am fully aware that I have posed a series of questions we should not have expected Mr. Clark to answer. These are questions for the profession as a whole. They are questions for an international meeting of the world's best agricultural economists assembled to discuss the economics of technical change. I do hope these will open a spontaneous, on-the-spot discussion. If they do not, I hope you will consider them in your work in your home countries.

M. CÉPÈDE, *National Institute of Agronomy, Paris, France*

It seems to follow from Colin Clark's paper that, at least in highly developed economies, technical developments are generally used in part to increase leisure. This is not always the case.

First, as he reminds us, in an agricultural economy in which demands for labour are very irregular, the first effect of technical progress is to reduce seasonal under-employment. At this stage 'enforced leisure' tends to diminish and not to increase with technical progress.



Egbert de Vries and O. Zaglitz demonstrated in a paper to the conference on population in Rome last year that the maintenance of a work-animal in Indonesia does not in the first instance reduce the amount of human labour since the work done by the buffalo is no more than the human work done in maintaining it. Where then is the economic progress resulting from this technical development? It is that human labour is spread out over the whole year and is put in reserve to be used in the form of animal work during labour peaks which would otherwise constitute a bottle-neck in production.

The second stage in economic progress will result from a system of production ensuring a more constant use of animal labour.

It is important, perhaps, to notice that in so-called highly developed countries the same phenomenon may be encountered. In a region of family farms in a climate which permits work all the year round, such as western France, systems of production were set up with a view to ensuring the full employment of labour during the whole year. And in the mountainous regions any form of technical progress which would allow enforced leisure to be reduced would be welcome. In the most advanced capitalist economies, the seasonal employment of manual labour tends to become more pronounced—as with the production of sugar-beet in Germany. Technical progress on such farms brings with it an increase in leisure, but this leisure is enforced, and cannot be assimilated without care into economic and, even more important, social progress.

If such progress came about, perhaps we should see in agriculture as well as in industry the grounds for a legitimate claim to a guaranteed annual wage, ensuring for the paid worker in agriculture a permanent livelihood similar to that given to work animals and to that which the master in earlier times gave to his slaves.

The increase in 'leisure' therefore should not be considered as a necessary consequence of technical progress and certainly not as a criterion for economic and social progress.

D. R. DENMAN, *University of Cambridge, England*

I have been intrigued by the wording of some questions which have been put before us this morning, more especially after Colin Clark's refreshing admonition over the phraseology of our papers.

One question was, 'in what way should we begin to put these facts and concepts together?' When thinking about that, we must bear in mind the people to whom we are addressing our remarks—presumably the agriculturists and landowners of our countries. I cannot

think that the bulk of them will begin to understand what we are trying to tell them if we talk to them in the way we have talked to each other at this Conference.

Look at the wording of another of the questions, 'Can we develop a useful, consistent, conceptual framework with substantive empirical content in which to consider the relationships between technical change and prosperity in farming?' This is the kind of phraseology one has met in our papers and I ask, what does the questioner mean? He uses the word develop, 'Can we develop?' By so doing, he presupposes we have something to develop—that there is something already there. I have an idea that he does not mean that at all. I think he means to ask the question: 'Can we conceive?' or 'Can we create?' 'Can we think of a way, appropriate in all circumstances, of using empirical knowledge to judge how technical change influences farming prosperity?' This is a single illustration of the general confusion of expression which I criticize.

J. F. BOOTH, *Economics Division, Marketing Service, Department of Agriculture, Ottawa, Canada*

At the end of his remarks, Mr. Colin Clark made an observation which he may not consider a major one in relation to his paper, but it was interesting and important too. If I understood him correctly, he said that because the United States was already in a net deficit position with respect to trade in farm products, we might expect that the surplus problem, there and presumably elsewhere, by his definition, would soon disappear. If that is a correct interpretation of his point of view I would like to ask him whether the result he expects necessarily follows, particularly with the type of economic organization now found in many countries. Surely it is quite possible to have a net deficit in agricultural trade as a whole and at the same time to have a continuation of surplus problems in particular products. That has been illustrated in the United States for the past twenty-five or thirty years in wheat production. I can well recall that thirty years ago, when the production of wheat in that country was around 800 million bushels, and national consumption about 600 million bushels, it was suggested that they would soon be on an import basis, because consumption was rapidly overtaking production and exports of farm products were declining. Well, today the United States is producing 1,200 million bushels of wheat a year, and the surplus has increased despite the overall deficit position.

Apart from the fact that comparative advantage is still a factor in

production and trade, we have the added consideration that it is now the policy of many countries to protect agriculture in various ways. Some forms of protection, whatever their advantages, could contribute to the surplus problem.

SHERMAN E. JOHNSON, *U.S. Department of Agriculture, Washington, D.C., U.S.A.*

I have two comments. One is on the statement Dr. Booth has just made. I certainly agree that we could continue to have surpluses of specific products in the United States even though we become a net importing nation in agricultural products. I do not have the exact figures but I seem to recall that at the present time our agricultural imports about balance our exports in total value. But of course our agricultural imports are largely tropical products like coffee, tea, and bananas. To me, the question of surpluses within our own agricultural production becomes a question of achieving production balance over time, and that is extremely difficult whether we are operating under support prices and specific farm programmes or in a free market. I am not at all sure that a free market would balance our production more quickly than some well-conceived programmes, but of course I think we all admit that our present programmes are subject to improvement.

Now one remark about Glen Johnson's excellent comments and the question that he raised, I think that we all should be concerned with better analysis of technical change, and that we do need a conceptual framework for better analysis; but I would like to emphasize something else. It seems to me that in the countries which are just beginning agricultural economics research, and which have rather small budgets, the really big problem from the standpoint of realizing benefits of technical change is to develop programmes that will make these benefits available to their farmers as quickly as possible. A colleague of mine working in the southern part of our country stated the problem in this way: that we need different tools to mine diamonds from those needed to mine coal. Effective and badly needed research can be done with quite simple tools. I think that in a good many countries, perhaps in all countries, we have a lot of coal mining to do. I suspect that in the countries that are just developing their economic research the coal mining is most important. But when I say that, I certainly do not want to belittle the need for a better conceptual framework and for research on the meaning of technical advance.

GLEN. L. JOHNSON, *Michigan State College, U.S.A.*

I would like to carry Sherman Johnson's analogy one step farther and point out that while a diamond can be admired for its own sake it can also be put on the end of a drill and used to mine coal.

G. P. WIBBERLEY, *Wye College, University of London*

There is an association of ideas at this stage in the Conference which has interested me. It has been implied by both Schultz and Colin Clark that a large amount of technical progress in agriculture in certain of the more highly developed countries can be attributed to the expenditure made on both general and technical education. They have, in fact, both suggested, either directly or by implication, that expenditure on general and technical education is far more worthwhile than investment in certain forms of physical agricultural improvement. Land reclamation was one example given. Professor Schultz is of the opinion that American experience lies behind and supports such suggestions. Both these two speakers have been describing a correlation but I am less clear as to whether both cause and effect are in this correlation because certain of Colin Clark's suggestions this morning have come out of residuals rather than from what has been measured. Earlier this week Dr. Raeburn emphasized very strongly that there are many *unfinished* technical improvements which have not been brought to the vital stage of being applicable in farming practice and in the farm economies of the particular place and time. Here again is something which blurs the association between expenditure on education and technological advance in agriculture.

Arising out of these comments there surely is a contribution which the more strongly developed schools of agricultural economic thought could make. Could they not examine the worthwhileness of community funds spent in education, and in particular in agricultural technical education, in relation to money invested in other forms of agricultural improvement? Very often agricultural politicians and administrators find big schemes of land reclamation and farm re-settlement more attractive propositions. If the more advanced and better funded schools of agricultural economics show how relatively cheap expenditure on education and research is in relation to increased agricultural output, it would surely help some of the more mal-developed countries to make more realistic budgets. It could possibly save them spending large sums of money on schemes of physical agricultural improvement which, if the Schultz-Clark analysis is right, would be less economic.